

SAMSUNG

ELECTRONICS

Product information

Customer :Xoceco**SAMSUNG TFT-LCD****MODEL : LTA460HA07 ('09 Spring Model)**

Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

Customer's Approval

SIGNATURE

DATE

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13.Mar. 2009

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13.Mar. 2009

LCD Business**Samsung Electronics Co . , LTD.****MODEL****LTA460HA07****Doc. No****06-000-G-090313****Page****1 / 29**

Contents

Revision History	(3)
General Description	(4)
General Information	(4)
1. Absolute Maximum Ratings	(5)
2. Optical Characteristics	(7)
3. Electrical Characteristics	(10)
3.1 TFT LCD Module	
3.2 Back Light Unit	
3.3 Inverter Input Condition & Specification	
4. Block Diagram	(13)
5. Input Terminal Pin Assignment	(14)
5.1 Input Signal & Power	
5.2 Inverter Input Pin Configuration	
5.3 Inverter Input Power Sequence	
5.4 LVDS Interface	
5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color	
6. Interface Timing	(19)
6.1 Timing Parameters (DE only mode)	
6.2 Timing Diagrams of interface Signal (DE only mode)	
6.3 Power ON/OFF Sequence	
7. Outline Dimension	(22)
8. Reliability Test	(24)
9. Packing	(25)
10. Marking & Others	(26)
11. General Precaution	(27)
11.1 Handling	
11.2 Storage	
11.3 Operation	
11.4 Operation Condition Guide	
11.5 Others	

MODEL	LTA460HA07	Doc. No	06-000-G-090313	Page	2 / 29
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*** Revision History**

Date	Rev. No	Page	Summary
Mar 13, 2009	000	all	First issued

MODEL**LTA460HA07****Doc. No****06-000-G-090313****Page****3 / 29**

General Description

Description

LTA460HA07 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit.

The resolution of a 46.0" is 1920 x 1080 and this model can display up to 16.7 Million colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide an excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV.

Features

- RoHS compliance (Pb-free)
- High contrast & aperture ratio
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm 178^\circ$)
- High speed response
- FHD resolution (16:9)
- Low Power consumption
- Direct Type 16CCFLs (Cold Cathode Fluorescent Lamp)
- DE (Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface

General Information

Items	Specification	Unit	Note
Module Size	1083(H _{TYP}) x 627(V _{TYP})	mm	±1.0mm
	57.5(D _{MAX})		
Weight	13,500 (Max.)	g	
Pixel Pitch	0.530(H) x 0.530(W)	mm	
Active Display Area	1018.08(H) X 572.67(V)	mm	
Surface Treatment	Haze 7%, Anti-glare	-	
Display Colors	8bit – 16.7M	Colors	
Number of Pixels	1920 x 1080	Pixel	
Pixel Arrangement	RGB vertical stripe	-	
Display Mode	Normally Black	-	
Luminance of White	430 (Typ.)	cd/m ²	

MODEL**LTA460HA07****Doc. No****06-000-G-090313****Page****4 / 29**

1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item		Symbol	Min.	Max.	Unit	Note
Power Supply Voltage		V_{DD}	GND-0.3	13	V	(1)
Storage temperature		T_{STG}	-20	60	°C	(2)
Glass surface temperature (Operation)	Center	T_{OPR}	0	50	°C	(2),(5)
	T. Uniformity	ΔT	-	10	°C	
Shock (non - operating)		S_{nop}	-	30	G	(3)
Vibration (non - operating)		V_{nop}	-	1.5	G	(4)

Note (1) $T_a = 25 \pm 2^\circ\text{C}$

(2) Temperature and relative humidity range are shown in the figure below.

a. 90 % RH Max. ($T_a \leq 39^\circ\text{C}$)

b. Relative Humidity is 90% or less. ($T_a > 39^\circ\text{C}$)

c. No condensation

(3) 11ms, sine wave, one time for $\pm X$, $\pm Y$, $\pm Z$ axis

(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

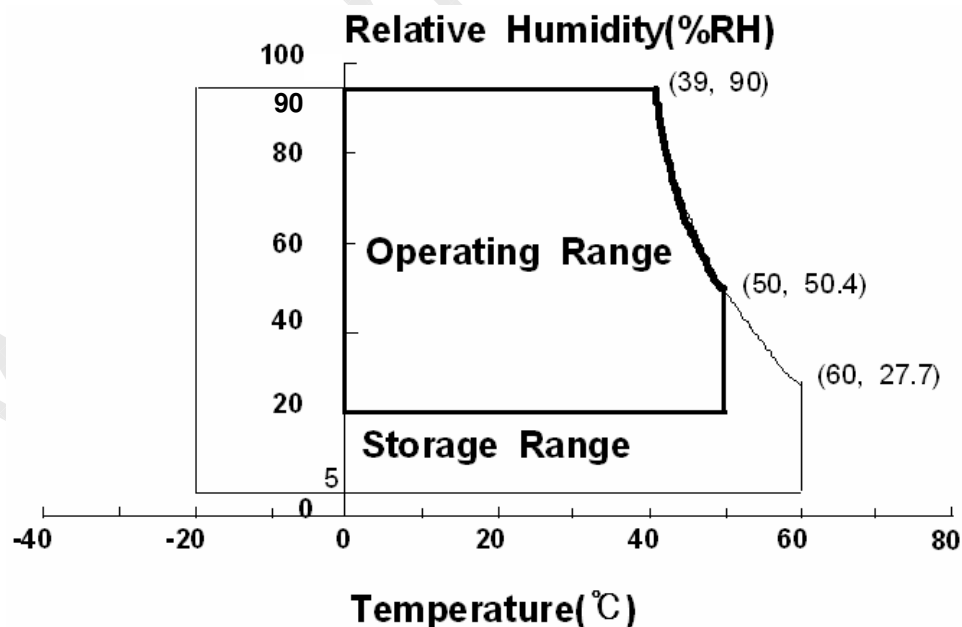
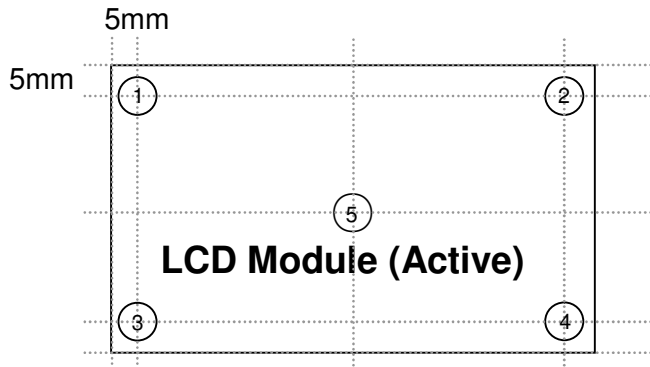


Fig. Temperature and Relative humidity range

(5) Definition of test point



ΔT should be less than $10\text{ }^{\circ}\text{C}$ ($\Delta T = |T_{\text{OPR}} - T_{\text{MAX}}|$)

T_{OPR} : Temperature of the center of the glass surface (Test point 5)
 $T_1 \sim T_4$: Temperature of each edge of the glass surface
 T_{MAX} : The highest temperature of the glass surface

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON RD-80S, TOPCON SR-3 ,ELDIM EZ-Contrast

(Ta = 25 ± 2°C, VDD=12.0V, fv=60Hz, f_{DCLK}=148.5MHz, Max. Dimming =3.3V)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$ Viewing Angle	2,500	4,000	-		(1) SR-3
Response Time	G-to-G	Tg		-	8	10	msec	(3) RD-80S
Luminance of White (Center of screen)		Y _L		370	430	-	cd/m ²	(4) SR-3
Color Chromaticity (CIE 1931)	Red	R _x		TYP. -0.03	0.630	TYP. +0.03		(5),(6) SR-3
		R _y			0.330			
	Green	G _x			0.285			
		G _y			0.605			
	Blue	B _x			0.150			
		B _y			0.060			
	White	W _x			0.280			
		W _y	0.290					
Color Gamut		-	-	72	-	%	(5) SR-3	
Color Temperature		-	-	10,000	-	K		
Viewing Angle	Hor.	θ _L	C/R≥10	75	89	-	Degree	(6) EZ-Contrast
		θ _R		75	89	-		
	Ver.	θ _U		75	89	-		
		θ _D		75	89	-		
Brightness Uniformity (9 Points)		B _{uni}		-	-	25	%	(2) SR-3

- Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

. Max. Dimming = 3.3V

. Environment condition : Ta = 25 ± 2 °C

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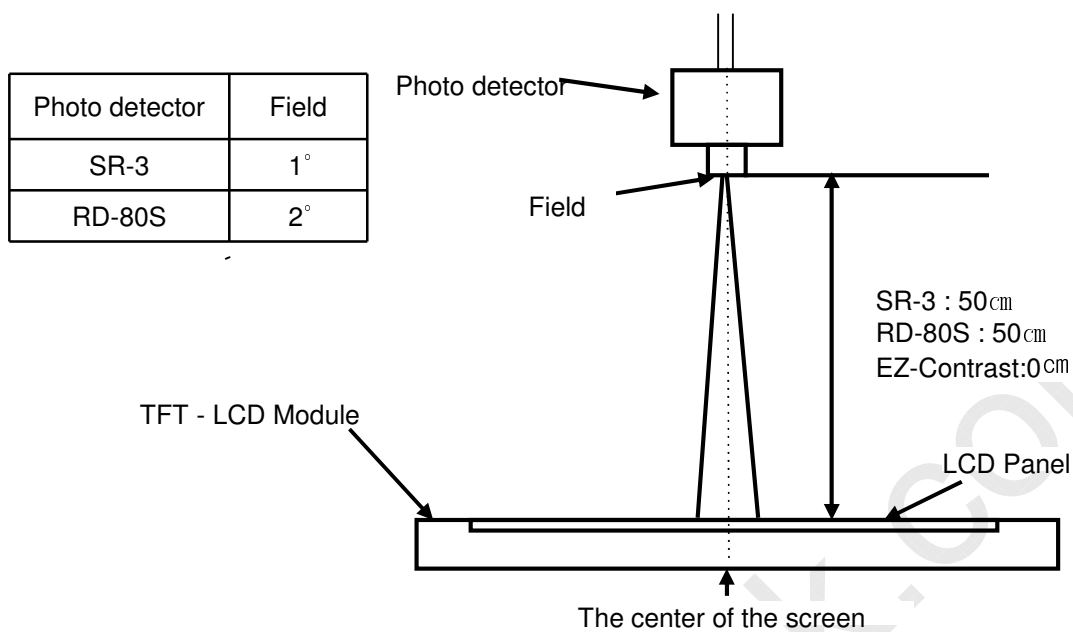
LTA460HA07

Doc. No

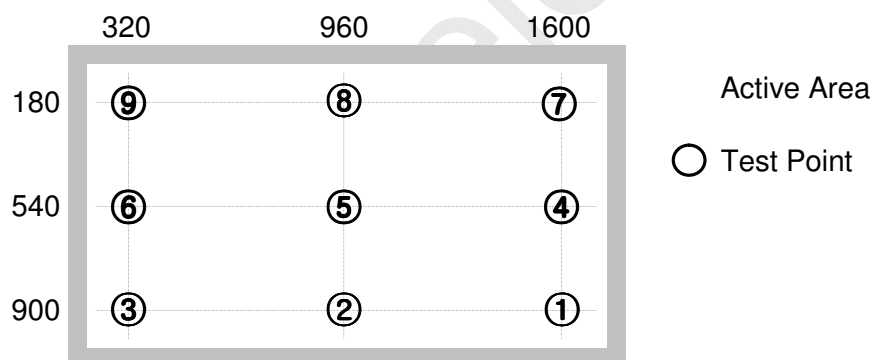
06-000-G-090313

Page

7 / 29



- Definition of test point



Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

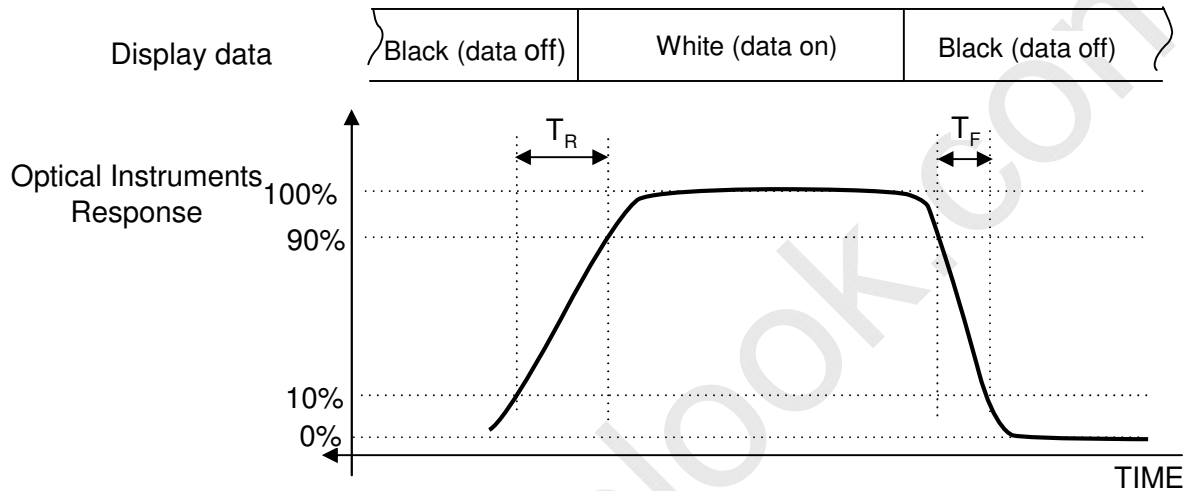
Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White)

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

B_{max} : Maximum brightness

B_{min} : Minimum brightness

Note (3) Definition of Response time : Sum of T_r, T_f



※ G-to-G : Average response time between Gray to Gray (Scale)

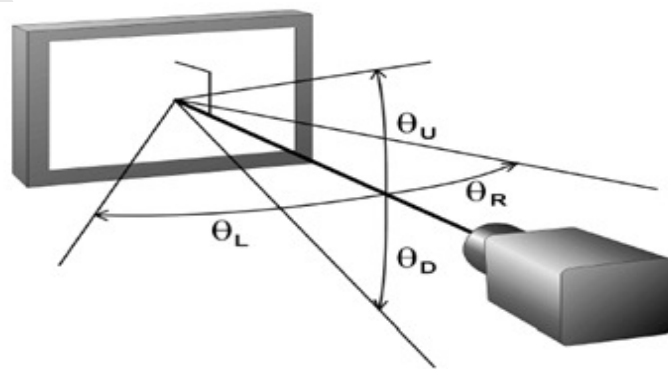
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle

: Viewing angle range (C/R ≥ 10)



3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	10.8	12.0	13.2	V	(1)
Current of Power Supply	(a) Black	I _{DD}	-	800	1000	mA	(2),(3)
	(b) White		-	1100	1300	mA	
	(c) N-pattern		-	1300	1500	mA	
Vsync Frequency		f _V	45.0	60.0	64.0	Hz	
Hsync Frequency		f _H	60.0	67.5	70.0	kHz	
Main Frequency		Fdclk	130.0	148.5	155.0	MHz	
Rush Current		I _{RUSH}		-	4.5	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD} .

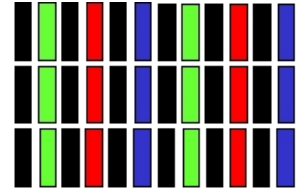
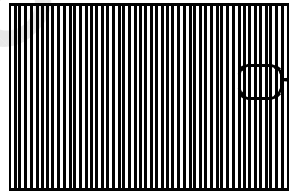
(2) $f_v=60\text{Hz}$, $f_{DCLK}=148.5\text{MHz}$, $V_{DD}=12.0\text{V}$, DC Current.

(3) Power dissipation check pattern (LCD Module only)

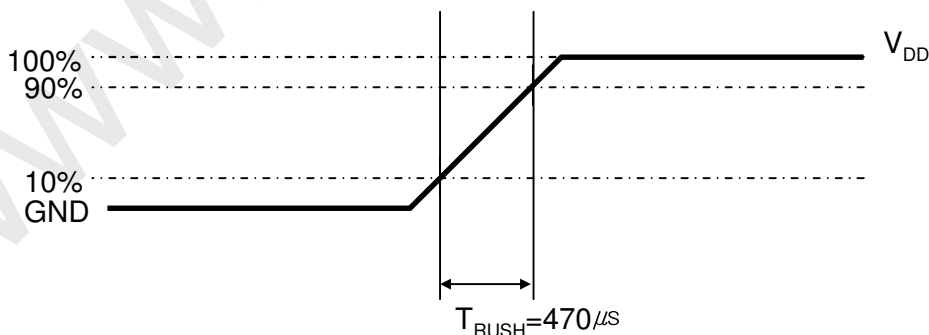
a) Black Pattern

b) White Pattern

c) N - Pattern



(4) Measurement Conditions

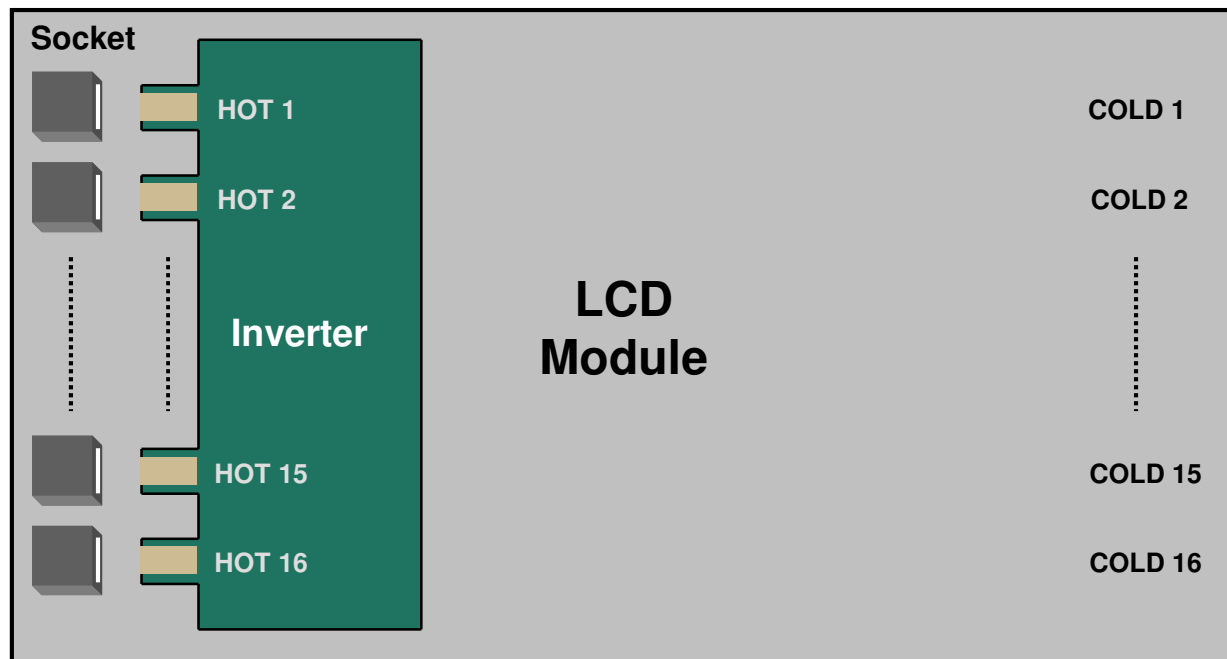


Rush Current I_{RUSH} can be measured when T_{RUSH} is $470\mu\text{s}$.

3.2 Back Light Unit

The back light unit contains 16 direct-lighting type CCFLs (Cold Cathode Fluorescent Lamp). The characteristics of lamps are shown in the following tables.

$T_a = 25 \pm 2^\circ\text{C}$



Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	50,000	-	-	Hour	(1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : $T_a = 25 \pm 2^\circ\text{C}$, $I_L = \text{TBD}$, For single lamp only.]

3.3 Inverter Input Condition & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	V _{in}	-	22	24	26	V	Ta=25±2 °C
Input Current	I _{RUSH}	V _{in} = 24V V _{dim} = 3.3V	-	-	9.4	A	(1)
			-	-	8.25		(2)
Lamp Current	I _O	V _{in} = 24V V _{dim} = 3.3V	10.0	10.5	11.0	mArms	(2)
Frequency	F _{LAMP}	V _{in} = 24V	31.0	32.5	34.0	kHz	-
Backlight On/Off	ON	V _{in} = 24V	2.4	-	5.5	V	(3)
	OFF	V _{in} = 24V	0	-	0.8		
Dimming Control	V _{DIM}	Max Lum	3.3	-	-	V	(4)
		Min. Lum	-	-	0		

Note) Power Consumption is measured when 430[cd/m²] of luminance which is the typical luminance.

Lamp Current is measured at the point before Lamp.

(1) Max Value of the Power Consumption is measured during initial turn-on time* of the backlight.

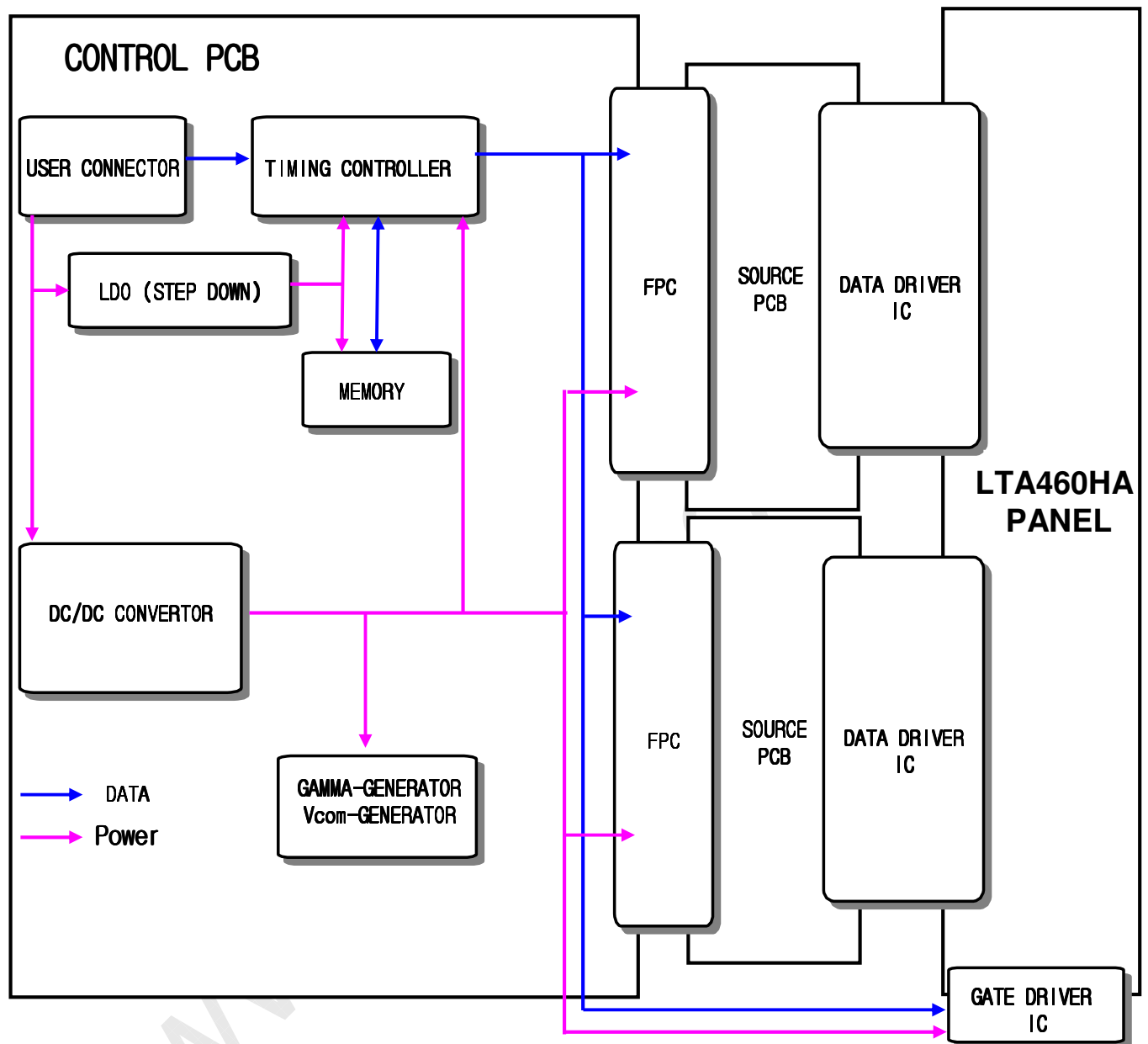
(2) Max Value of the Power Consumption is measured after 60 min warm-up.

(3) Inverter pin NO.12 is for backlight On/Off.

(4) Inverter pin NO.13 is for dimming control.

* Initial turn-on time : From 0sec to 60min after turn-on

4. Block Diagram



5. Input Terminal Pin Assignment

5.1. Input Signal & Power

Connector : FI-RE51S-HF (JAE)

Pin	Symbol	Description	Pin	Symbol	Description
1	12V	DC power supply	26	RE[0]P	Even LVDS Signal +
2	12V	DC power supply	27	RE[1]N	Even LVDS Signal -
3	12V	DC power supply	28	RE[1]P	Even LVDS Signal +
4	12V	DC power supply	29	RE[2]N	Even LVDS Signal -
5	12V	DC power supply	30	RE[2]P	Even LVDS Signal +
6	NC	NOTE1	31	GND	Ground
7	GND	Ground	32	ROCLK-	Even LVDS Clock -
8	GND	Ground	33	ROCLK+	Even LVDS Clock +
9	GND	Ground	34	GND	Ground
10	RO[0]N	Odd LVDS Signal -	35	RE[3]N	Even LVDS Signal -
11	RO[0]P	Odd LVDS Signal +	36	RE[3]P	Even LVDS Signal +
12	RO[1]N	Odd LVDS Signal -	37	NC	NOTE1
13	RO[1]P	Odd LVDS Signal +	38	NC	
14	RO[2]N	Odd LVDS Signal -	39	GND	Ground
15	RO[2]P	Odd LVDS Signal +	40	NC	NOTE1
16	GND	Ground	41	NC	
17	ROCLK-	Odd LVDS Clock -	42	NC	
18	ROCLK+	Odd LVDS Clock +	43	NC	
19	GND	Ground	44	NC	
20	RO[3]N	Odd LVDS Signal -	45	LVDS_SEL	NOTE2
21	RO[3]P	Odd LVDS Signal +	46	NC	NOTE1
22	NC	NOTE1	47	NC	
23	NC		48	NC	
24	GND	Ground	49	NC	
25	RE[0]N	Even LVDS Signal -	50	NC	
			51	NC	NOTE1

Note1) No Connection: These PINS are used only for SAMSUNG. (DO NOT CONNECT)

Note2) LVDS OPTION : If this PIN is HIGH (3.3 V) → Normal LVDS format

LOW (GND) → JEIDA LVDS format

SEQUENCE : On = $V_{DD}(T1) \geq \text{LVDS Option} \geq \text{Interface Signal}(T2)$

OFF = $\text{Interface Signal}(T3) \geq \text{LVDS Option} \geq V_{DD}$

MODEL

LTA460HA07

Doc. No

06-000-G-090313

Page

14 / 29

Note(1) Pin number starts from Left side

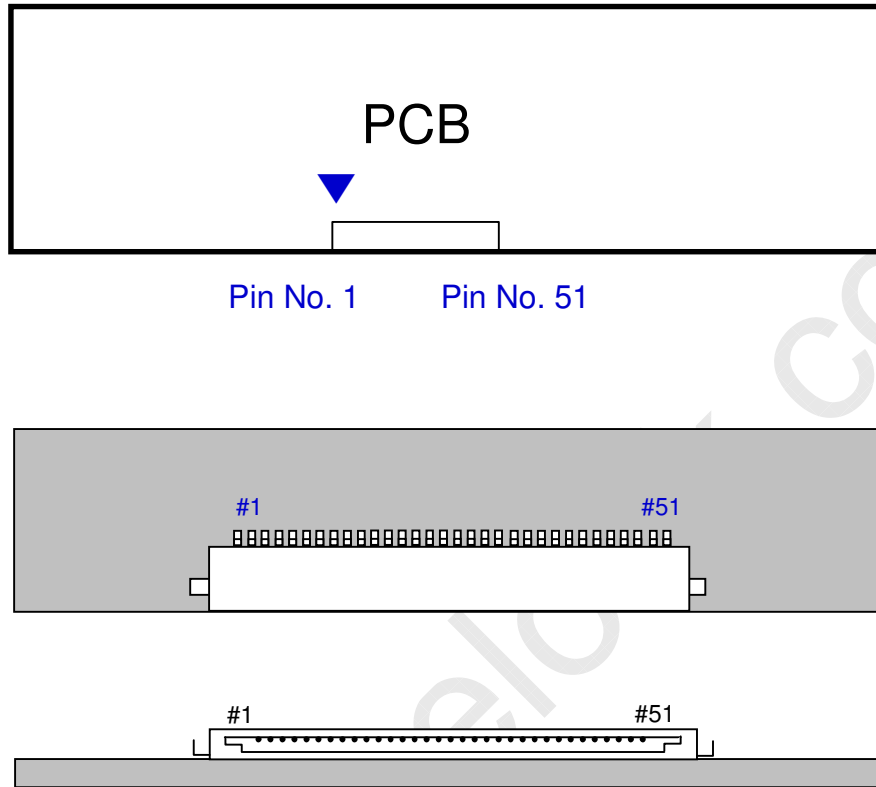


Fig. Connector diagram

- a. Power GND pins should be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pin should be separated from other signal or power.

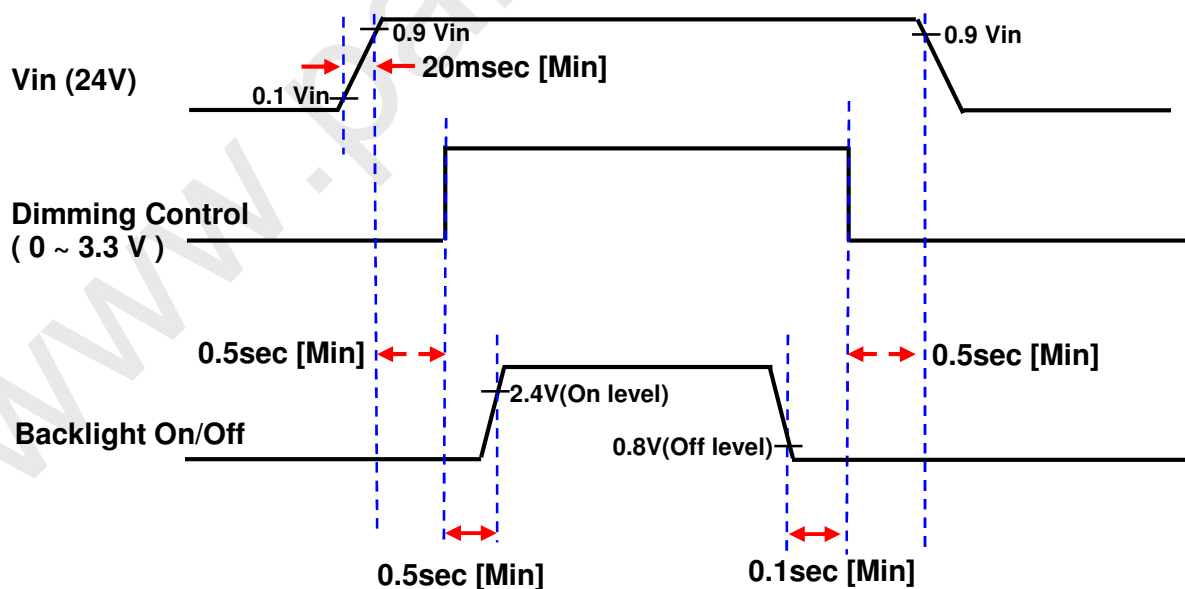
MODEL	LTA460HA07	Doc. No	06-000-G-090313	Page	15 / 29
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5.2 Inverter Input Pin Configuration

Connector : YEONHO, 20022WR-14B1

Pin No.	Pin Configuration (FUNCTION)
1	Vin (24 V)
2	Vin (24 V)
3	Vin (24 V)
4	Vin (24 V)
5	Vin (24 V)
6	GND
7	GND
8	GND
9	GND
10	GND
11	No Connection (DO NOT CONNECT)
12	Backlight On /Off [ON: 2.4 ~ 5.5 V, OFF: 0 ~ 0.8 V]
13	Dimming Control [0V: Min, 3.3V: Max]
14	No Connection (DO NOT CONNECT)

5.3. Inverter Input Power Sequence



5.5 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	DATA SIGNAL																												GRAY SCALE LEVEL
		RED								GREEN								BLUE												
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7					
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-			
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-			
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-			
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-			
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-			
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-			
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-			
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0			
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1			
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~ R252			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253			
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254			
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255			
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0			
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1			
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~ G252			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G253			
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254			
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G255			
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0			
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B1			
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B2			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~ B252			
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	B253			
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254			
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B255			

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

MODEL

LTA460HA07

Doc. No

06-000-G-090313

Page

18 / 29

6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	130.0	148.5	155.0	MHz	-
Hsync		F_H	60.0	67.5	70.0	KHz	-
Vsync		F_V	45.0	60.0	64.0	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	Lines	-
	Vertical Total	T_V	1092	1125	1380	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	Clocks	-
	Horizontal Total	T_H	2090	2200	2350	clocks	-

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

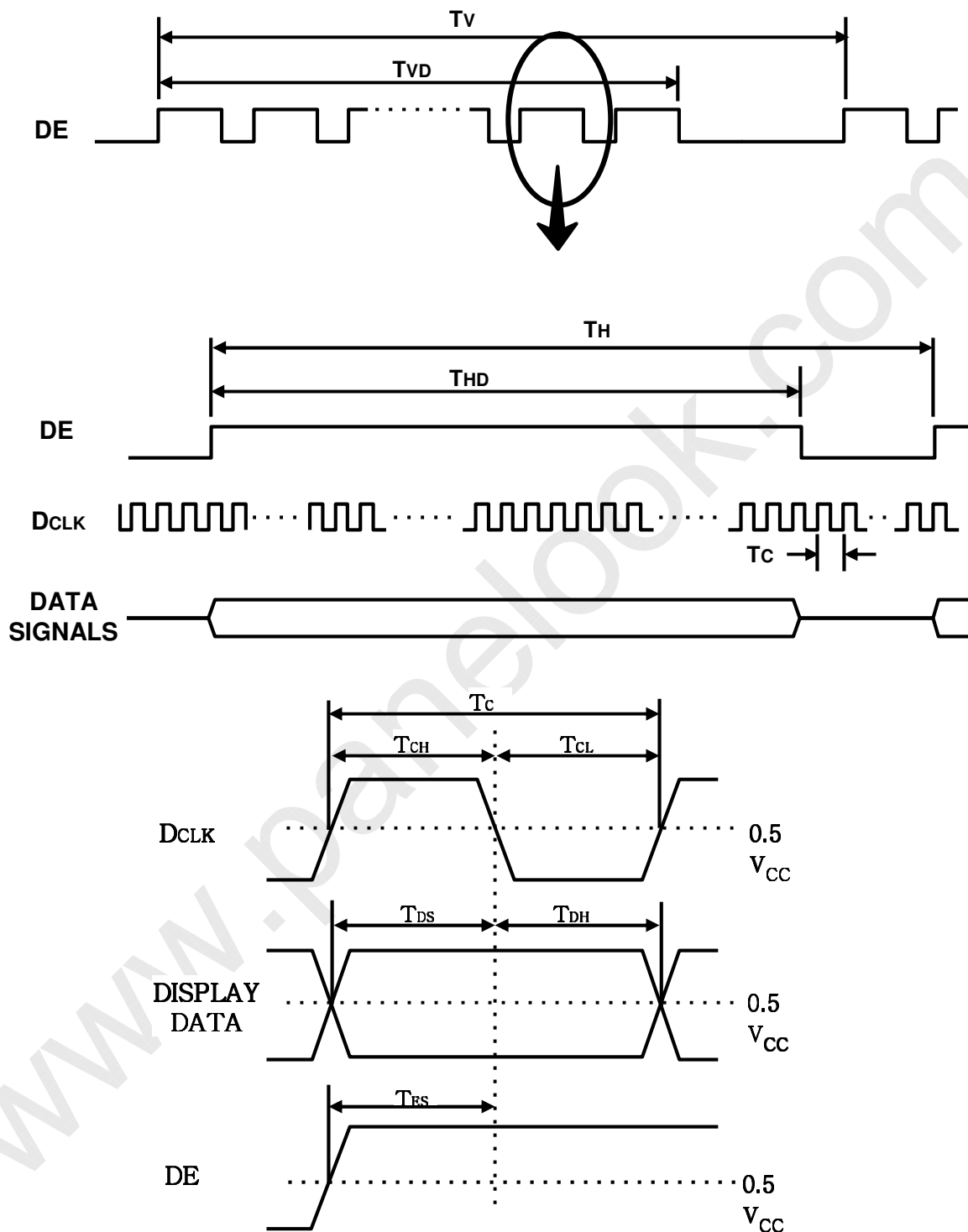
(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal $V_{DD} = 3.3V$

(3) Spread spectrum

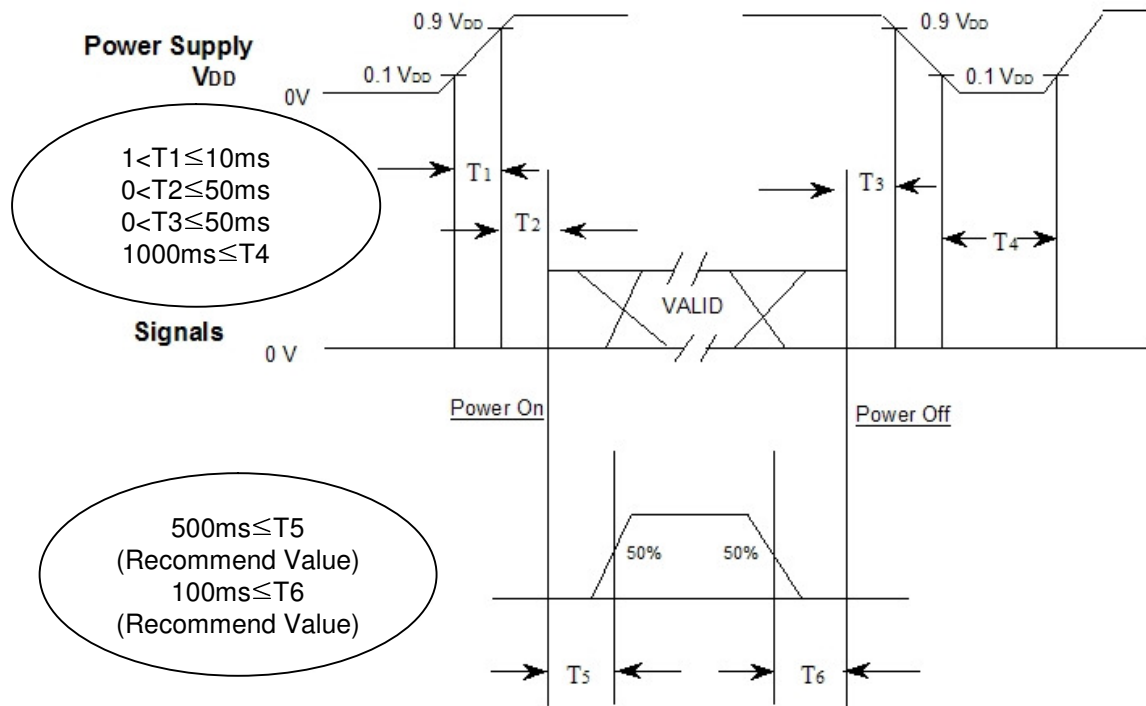
- Modulation rate (max) : $\pm 1.5 \%$
- Modulation Frequency : under 100KHz

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



T1 : V_{DD} rising time from 10% to 90%

T2 : The time from V_{DD} to valid data at power ON.

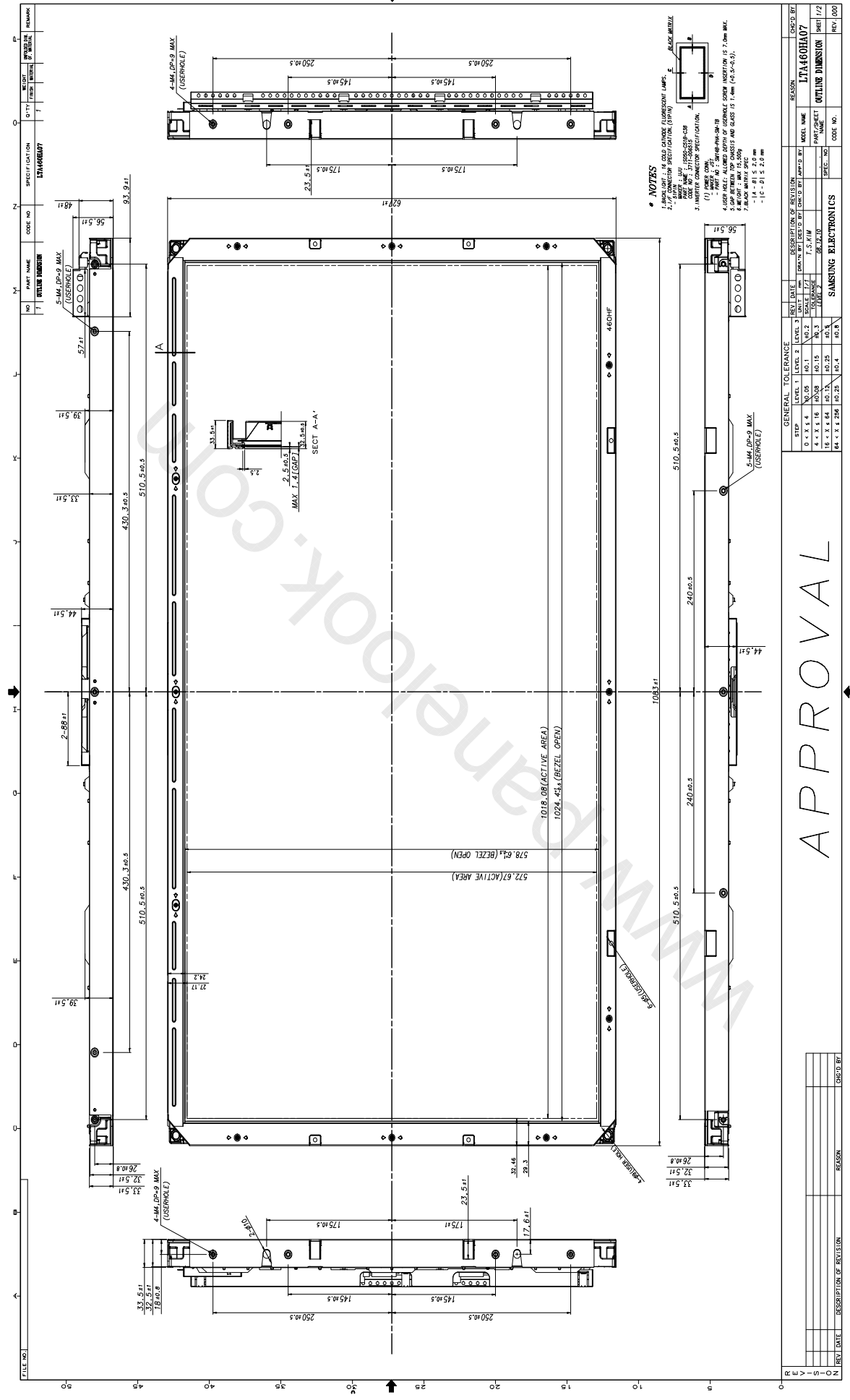
T3 : The time from valid data off to V_{DD} off at power Off.

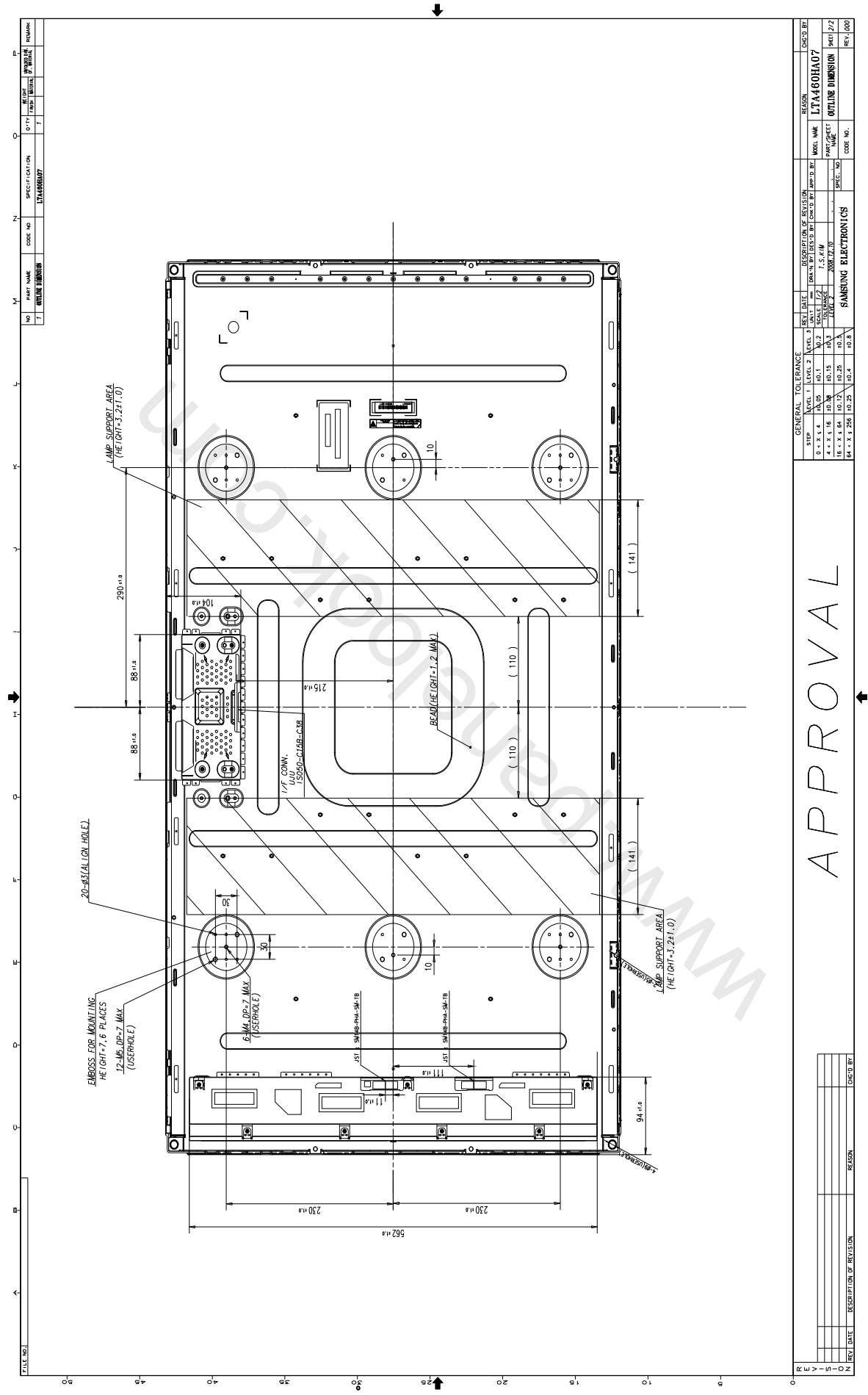
T4 : V_{DD} off time for Windows restart

T5 : The time from valid data to B/L enable at power ON.

T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.





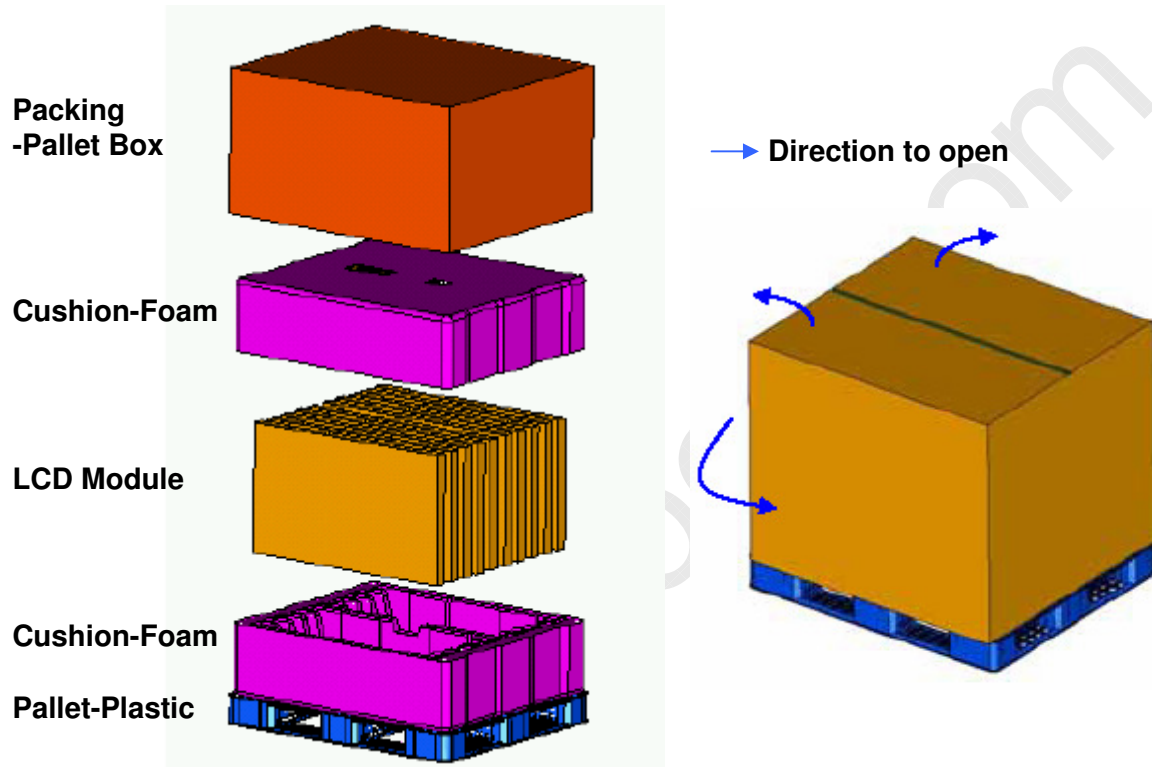
9. PACKING

9.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



9.2 Packing Specification

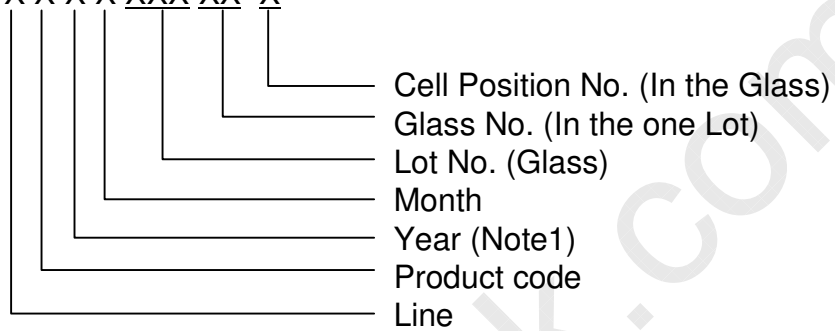
Item	Specification	Remark
LCD Packing	10ea / (Packing-Pallet Box)	1. 130 Kg / LCD (10ea) 2. 10 Kg / Cushion-pallet (2ea) 3. 8 Kg / Packing-Pallet Box (1ea) 4. Cushion-pallet Material : EPS 5. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8.8kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 844mm(height)
Total Pallet Weight	157 kg	Pallet(8.8kg) + Module(130kg) + Cushion(up+bottom=10kg) + Pallet-BOX(8kg)

MODEL**LTA460HA07****Doc. No****06-000-G-090313****Page****25 / 29**

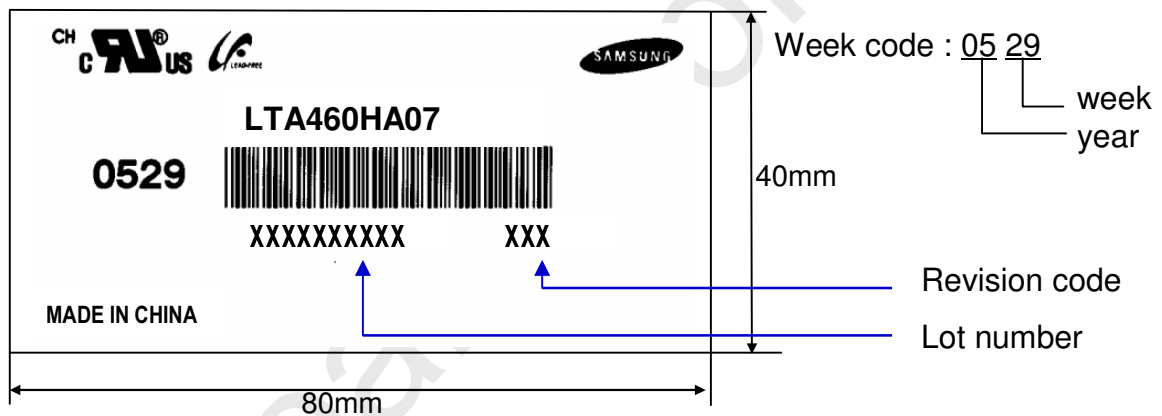
10. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

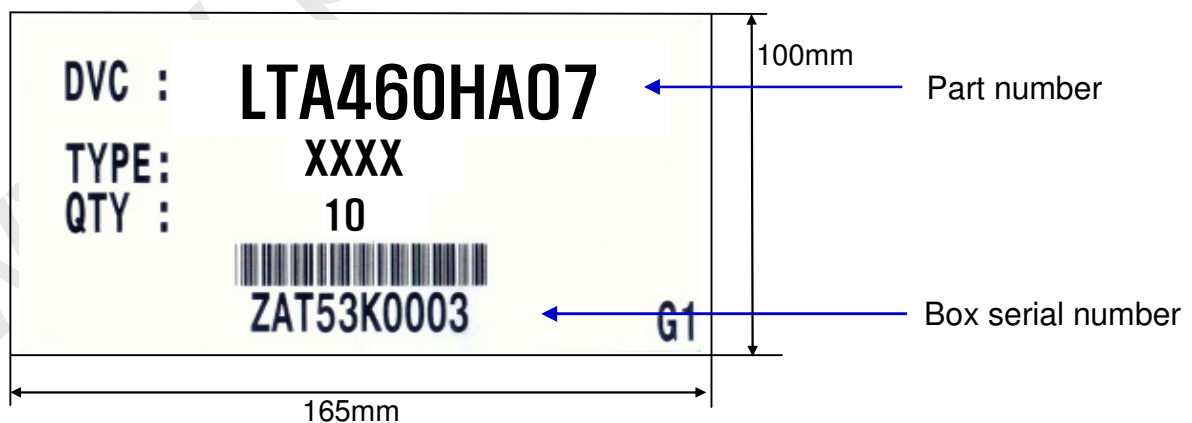
- (1) Part number : LTA460HA07
- (2) Revision: Three letters
- (3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

MODEL	LTA460HA07	Doc. No	06-000-G-090313	Page	26 / 29
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11. General Precautions

11.1 Handling

- (a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.
- (b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and / or any force to the Module.
In addition to damage, this may cause improper operation or damage to the Module and CCFL back light.
- (d) Note that polarizers are very fragile and could be damage easily.
Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.
- (i) Protect the module from Electrostatic discharge. Otherwise the ASIC IC or Semiconductor would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the Module.
- (l) Do not disassemble shield case of inverter & LVDS board.
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handle a module
- (o) Pins of I/F connector should not be touched directly with bare hands.

MODEL	LTA460HA07	Doc. No	06-000-G-090313	Page	27 / 29
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11.2 Storage

- (a) Do not leave the Module in high temperature, and high humidity for a long time. It is highly recommended to store the Module with temperature from 0 to 35 °C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD Module in direct sunlight.
- (c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

11.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(V_s).

11.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $55 \pm 20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

MODEL	LTA460HA07	Doc. No	06-000-G-090313	Page	28 / 29
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11.5 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the Module may be damaged.
- (d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked " to the screen.
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.

MODEL**LTA460HA07****Doc. No****06-000-G-090313****Page****29 / 29**